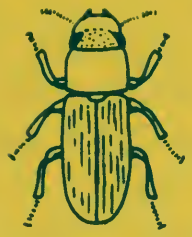

control of INSECTS and MITES in FARM-STORED GRAIN in the prairie provinces

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GOOD STORAGE PRACTICES

You can prevent losses from insects by storing your grain properly.

- The first step is to harvest the grain as dry as possible. Dry grain (under 14.6 percent moisture) is less likely to become infested than tough grain (between 14.6 and 17.0 percent).
- Late seeding or poor harvesting weather may make it difficult to harvest grain dry. Therefore, give extra attention to preparing your granary: sweep the walls and floor, burn the sweepings, weatherproof the building, and spray the walls and floor with a recommended insecticide.
- For additional protection against insects, spray the grain with an approved insecticide as it is binned.
- Examine stored grain every 2 weeks for signs of insects or mites. If infestations develop, fumigation may be needed. Fumigation is difficult and hazardous and should only be done by experienced persons. During winter, infestations may be controlled by moving the grain to another bin to lower grain temperature.

Remember – it is easier, safer, and less expensive to prevent infestations than it is to eradicate them once they have started.

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Control of INSECTS AND MITES IN FARM-STORED GRAIN in the Prairie Provinces

F. L. Watters
Research Station, Winnipeg, Manitoba

Each year storage pests cut farm profits. Insects and mites are the worst offenders. They damage stored grain by eating it and causing it to heat and spoil. Infested grain is hard to sell and heated grain is down-graded. These losses may be prevented by taking steps to keep the grain from becoming infested. This will maintain the quality of the grain and ensure that it will be salable at all times.

Molds also damage stored grain. But the good storage practices that prevent infestations by insects and mites usually prevent mold damage.

Because there are penalties for shipping infested grain to terminal elevators, infestations must be prevented or eradicated before the grain is delivered or shipped.

COMMON PESTS OF STORED GRAIN

The insects and mites that cause the most damage in farm-stored grain in the Prairie Provinces are as follows. *The lines beside the drawings indicate the actual length of each insect.*

Beetles

The rusty grain beetle is a flat, reddish-brown insect about 1/16 inch long. It can move quickly in warm grain and may fly when the air temperature is above 75° F. The larvae usually chew their way into the germ of kernels, where they feed and complete their development.

The foreign grain beetle is a reddish-brown beetle about 1/16 inch long. It commonly feeds on moldy grain containing large amounts of dockage. Although this is the most common fungus beetle found in the Prairie Provinces, other species also occur.

The granary weevil is dark brown and is about 1/8 inch long. It has a distinctive snout. The female chews a hole in the side of a kernel, lays an egg in it, and then seals the hole. The insect develops from egg to adult inside the kernel.

The red flour beetle and the confused flour beetle resemble each other. Both are reddish brown and are about 1/8 inch long. The larvae feed extensively on the germ of wheat kernels but also live on grain dust, flour, and animal feeds. Both species may be associated with heating grain.

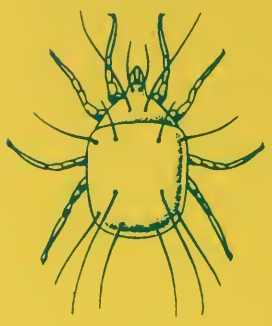
The saw-toothed grain beetle and the merchant grain beetle resemble each other. The adults are dark brown and 1/8 inch long. The larvae feed on the germ of wheat kernels, and both the larvae and the adults may feed on grain dust. Both species may infest a wide range of processed foods.

The hairy spider beetle is found occasionally at the surface of stored grain. It is dark brown, has long spiderlike legs, and is 1/8 inch long. Although the larvae damage kernels extensively, they seldom occur in large enough numbers to cause serious damage to stored grain. They are important pests of flour warehouses.

Moths

The meal moth is the only species of moth commonly found in farm-stored grain in the Prairie Provinces. Usually this moth only infests tough grain. The larvae web the kernels together and form cocoons inside the cluster. The larva is cream-colored and has a black head. The forewings of the adult are dark brown at the base and tip and have broad gray areas in between.

Mites



The grain mite and the long-haired mite are the most important mite pests of stored grain. The grain mite feeds mostly on the germ of the kernel and the long-haired mite feeds mostly on grain dust and dockage. Mites give a strong "minty" odor to the grain they infest. Because of their small size they are hard to see. Large numbers in grain siftings look like clumps of moving dust.

Psocids

Adult psocids are 1/25 inch long. They are minor pests of tough or damp stored grain. These insects are usually found with others that cause serious damage.

LOSSES DURING STORAGE

Excess moisture causes most of the problems in stored grain. Unfavorable harvesting weather may force farmers to store large quantities of grain that has a high moisture content. As long as the moist grain stays cool, insects, mites, and molds do little damage. But when spring comes, grain temperatures will rise and infestations may occur.

Even when grain has been stored in a dry condition, moist spots may develop during storage. Patches of grain may become moist when water vapor moves from warm to cool grain. Wet patches may also form when

Wheat damaged by stored-grain insects. A, undamaged kernel; B, germ damaged by the rusty grain beetle; C, germ damaged by the red flour beetle; D, germ damaged by the saw-toothed grain beetle; E, endosperm damaged by the granary weevil.

snow or rain penetrates the roof, walls, and ventilators. The increased moisture content of surface grain often leads to sprouting. Areas of tough or damp grain invariably form pockets where infestations multiply rapidly and heating occurs.

Insect-damaged wheat is easy to identify. Larvae of the rusty grain beetle damage kernels by chewing tiny holes in the germ, in which they complete their development. The adult beetles form inside the cavity and chew their way out. Larvae of the red flour beetle and the saw-toothed grain beetle may eat the entire germ. The granary weevil completes its development inside the endosperm of the kernel, and then emerges as an adult insect, leaving a ragged hole behind. Kernels that have been damaged by these insects may not only fail to germinate but may also harbor small insects, mites, and molds.

Pests may get into stored grain from various sources. Newly harvested stored grain may become infested with insects and mites that were hiding in floor and wall cracks of granaries or in accumulations of old grain on the granary floor. Pests that were on the ground outside may get into the grain. Birds' nests inside granaries are also sources of infestation. Some insects can fly as well as crawl and this increases their ability to infest fresh stocks of grain. Stored grain may also become infested while being transported in trucks that have carried infested grain or animal feeds. Mites and insects can hitchhike on animals and clothing and cause infestations to be carried between granaries.

TYPES OF GRAIN STORAGES

Well-constructed granaries are essential to prevent infestations and to preserve grain quality during long-term storage. The best granaries are weatherproof, have ventilators, and are of single-wall construction. Several 1,000- or 2,000-bushel granaries are better than larger ones because during winter, small bulks cool more rapidly and evenly than large bulks. Insects never become a problem in cool grain.

A circular steel granary on a dry concrete slab is best. When empty, it has fewer places for insects to breed in than a wooden granary has. It is also easier to fumigate. If there are cracks in the concrete floor, fill them with tar or a caulking compound. Then cover the floor with polyethylene or good-quality vaporproof paper to keep the grain from being spoiled by ground moisture.

Movable wooden granaries are satisfactory if you set them up on high ground that is well drained. You will probably have to repair them from time to time to keep them weatherproof since hot spots often start in grain under leaky roofs. Raise the granaries about 6 inches above the ground to allow the air to circulate and the grain to cool uniformly.

The cheapest and best emergency storages are made of plywood or paper-lined snow fence, each with a capacity of about 500 bushels. Place them on high, dry ground and cone the grain as high as possible at the center to shed rain and snow. Avoid using a plastic cover because it prevents the grain from drying naturally and may cause the grain to spoil at the surface.

Take extra precautions if you use vacant cattle barns and farm implement sheds to store surplus grain. Cracked concrete or earthen floors should be covered with heavy-gauge polyethylene sheets to prevent damage from soil moisture. Double walls built to keep cattle warm make good breeding places for insects and mites, especially in warm weather. To treat these places, remove the bottom boards, clean out the debris, and spray insecticide between the studs.

PREVENTING INFESTATIONS

It is easier and cheaper to prevent infestations of stored grain than to get rid of pests that are all through the grain. Prevention should start before the grain is harvested.

- Clean, repair, and weatherproof empty granaries. Burn or bury the sweepings.
- Spray floors and inside walls with malathion or pyrethrins – piperonyl butoxide.

- Harvest grain as dry as possible because insects, mites, and molds increase rapidly in tough grain.

- Avoid storing grain in bins next to animal feeds that are likely to be infested.

- Fill granaries only to the top plates to provide crawl spaces and to allow for ventilation.

- If grain has been binned tough, examine it every 2 weeks. To do this, crawl over the surface and feel the grain for warmth. Grain that is dry and cool seldom spoils.

- Always store new grain in a clean, empty bin. New grain invariably heats if it is loaded on top of old grain.

Insecticide Sprays

You may treat your empty, cleaned granaries by spraying the inside walls, top plates, and floors with 3 percent malathion or a bin spray containing 0.13 percent pyrethrins and 1.25 percent piperonyl butoxide.

Malathion is usually supplied as an emulsifiable concentrate. Dilute it with water to obtain a spray containing 3 percent malathion. Use the following example to calculate the number of parts of water to add to 1 part of 50 percent malathion concentrate: (50–3)/3 = 47/3 = 15.7 parts of water. Therefore, to make up a gallon of insecticide, add ½ pint of 50 percent malathion concentrate to 1 gallon of water.

Pyrethrins – piperonyl butoxide is usually supplied as an oil-base spray ready for treating storage premises.

Apply either the 3 percent malathion or the pyrethrins – piperonyl butoxide spray at 1 gallon per 1,000 square feet. Slightly over half a gallon will treat a 1,000-bushel granary. Make the application about a week before binning the grain.

Applying an insecticide spray to the inside walls and floor of a granary.

Lindane (1 percent) and methoxychlor (5 percent) are also used to treat the floors and walls of empty granaries, elevator bins, annexes, and flour warehouses. These insecticides are more persistent than malathion and pyrethrins – piperonyl butoxide, and are not recommended for use in areas that are on or near livestock premises.

Insecticide Fogs

Electric fogging machines may be used to apply insecticide to bins with high walls.

- Use a pyrethrins – piperonyl butoxide bin spray in an oil base; it should contain 0.13 percent pyrethrins and 1.25 percent piperonyl butoxide.
- Place the electric fogger at the center of the floor.
- Close all doors and ventilators to prevent air drafts during application.
- Switch on the fogger from outside the building.
- Apply the spray at 15 ounces per 1,000 cubic feet (the number of cubic feet in a bin can be calculated by multiplying the bushel capacity by 1.2).
- Wait a day after treatment before entering the bin to allow the insecticide particles to settle on the walls and floor.

Grain Treatment

As an added precaution you may treat grain with certain insecticides to protect it from infestation during storage. Special formulations of malathion and pyrethrins – piperonyl butoxide are available for this purpose. Take particular care to apply these insecticides at the rates recommended on the labels. Overtreating the grain produces chemical odors that lower the selling price.

Insecticides for treating stored grain are available as liquid concentrates. They should be mixed with water according to the directions on the labels. Spray the insecticide on the grain as it is binned at 3 to 5 gallons per 1,000 bushels. The treatment works best when the grain has less than 15 percent moisture and is in good storage condition.

DETECTING INFESTATIONS

Be sure to inspect your grain stocks often in order to detect the earliest sign of infestation. Sample the grain every 2 weeks to check for insects and signs of heating.

To check for insects, screen surface samples with a 10-mesh sieve; to obtain deep samples, use a sampling probe. Examine the siftings over slight heat to detect movement of insects. During summer, plastic cups filled with water may be used to trap grain-infesting insects. Insert the cups into the grain so that the top shows slightly above the grain surface. Examine the water traps regularly for insects.

To check for heating, feel the grain surface with your hands. Use a metal pipe to check the grain temperature below the surface.

CONTROLLING INFESTATIONS

Insects and mites may infest stored grain that is in poor storage condition or has not been properly protected. To keep the infestations from spreading, control them just as soon as you notice them. The type of treatment needed depends on the condition of the grain, grain temperature, and season of the year.

Moving Grain in Winter

The best way to control infestations during cold weather is to move grain from one bin or storage to another. It may be necessary to move only the grain that is heating, but several transfers may be needed to cool it to below 35° F. Insects do not damage grain or multiply at this temperature and many will die eventually.

Cleaning the grain also checks infestations. Burn all infested cleanings to prevent infestation of other grain stocks.

To control surface infestations of moths, mites, and spider beetles, it is usually enough to rake the grain and lower the temperature. Remove and destroy infested patches.

Fumigants

During spring, summer, and fall you may use fumigants to control stored-grain pests. Grain fumigants are usually supplied as liquids or solids. When applied to grain they form a gas that is poisonous to humans as well as to insects. Avoid inhaling the vapors, and handle the fumigants according to directions on the container labels. Many grain fumigants are supplied as mixtures of two or more fumigants; they assist one another in penetrating the grain mass and in killing insects.

There are three types of fumigants for treating farm-stored grain. These are: (1) liquid fumigant mixtures that contain carbon tetrachloride—these are usually sprayed on the grain surface; (2) liquid fumigants such as methyl bromide and ethylene dibromide mixtures, used as spot treatments; and (3) solid fumigants in tablet or spherical form.

Surface sprays – Fumigant mixtures containing carbon tetrachloride are applied at 3 to 6 gallons per 1,000 bushels of grain. The rate depends on the type of granary and the condition of the grain. Tightly constructed bins of metal or concrete require the smaller dosage, whereas wooden bins require 5 to 6 gallons per 1,000 bushels. Before spraying the grain, seal building cracks and crevices and other openings to keep the gas from escaping.

Apply the fumigant uniformly as a coarse spray on the grain surface through an opening from outside the granary. Use a bucket pump when applying 3 to 10 gallons of fumigant. Apply larger quantities with a gear pump driven by a 3.5-hp gasoline engine. Deliver it at 8 to 12 gallons per minute through 1/2-inch or, preferably, 1-inch rubber hose. Fumigant, pump, and engine may be kept at ground level.

Spot treatment – Most stored-grain infestations are concentrated in one or more locations in the grain bulk. These may be treated by applying the fumigant to the infested pockets. Use 1-inch metal pipes that have 1/16-inch holes drilled in the bottom 12 inches. Insert the pipes in and around the infested area and apply 6 to 12 fluid ounces of fumigant at each location.

A liquid fumigant consisting of methyl bromide and ethylene dibromide is suitable for spot fumigation. The mixture is supplied in small cans, each containing 6 fluid ounces. The entire surface of the grain may be fumigated by using cans of methyl bromide and ethylene dibromide or by pouring the fumigants down pipes inserted just below the grain surface. But this method takes longer than spraying, especially if the surface area is large.

Phosphine – This fumigant is manufactured as 3-gram tablets and 0.6-gram spherical pellets. They are packaged in airtight, moistureproof containers. When dropped or inserted in grain, they release a poisonous gas with a carbidelike odor. In granaries, use 100 to 180 tablets per 1,000 bushels and follow the manufacturer's recommendations on the label. The pellets are recommended for use in elevator bins with turning equipment, and in box cars; the dosage is 75 to 300 pellets per 1,000 bushels. They may be applied with an automatic dispenser.

There are two ways of applying the tablets to stored grain:

(1) Drop them into the grain at uniform time intervals as the bin is being filled.

(2) Drop them down a metal pipe inserted into the grain. For a 1,000-bushel granary, select about 12 points evenly spaced at the grain surface. Use a 4-foot length of 1-inch pipe. Insert the pipe at each point and drop a tablet every 6 inches as the pipe is being withdrawn. Start at the far end of the bin and work towards the door.

Open the granary ventilators 4 or 5 days after treatment to aerate the grain. The grain may have to be turned twice to remove the odor.

Wear a gas mask like one of these when handling or applying fumigants.

Cautions

When using fumigants, follow closely the directions on the fumigant label, especially the following:

- Always wear a full-face gas mask.
- Always fit a new canister before fumigating. Use an all-purpose canister for protection against the fumigants mentioned in this publication. The canister contains a chemical powder that absorbs the gas. But it does not provide protection for persons exposed to heavy concentrations inside buildings.
- Whenever possible, apply liquid fumigants from outside a granary as quickly as possible to avoid undue personal exposure.
- Always work with at least one other person.
- Wear rubber gloves.
- If the fumigant spills on your clothes, remove them at once.
- If a person is overexposed to the fumigant, move him to fresh air and call a doctor at once. The symptoms are dizziness, blurring of vision, vomiting, and abdominal pain.
- After fumigating a granary, nail or lock the doors and ventilators and post warning signs.

- After a week, open the ventilators but do not enter the granary until the odors have gone away. Fumigated grain may take several weeks to aerate during cold weather.

- Avoid feeding fumigated grain to cattle, unless the grain has been completely aerated and no odor remains.

MORE INFORMATION

For more information on the control of infestations in farm-stored grain, write to the Research Station, Canada Department of Agriculture, 25 Dafoe Road, Winnipeg 19, Manitoba.

SCIENTIFIC NAMES OF THE PESTS

Rusty grain beetle	*Cryptolestes ferrugineus* (Stephens)
Foreign grain beetle	*Adhasverus advena* (Waltl)
Granary weevil	*Sitophilus granarius* (Linnaeus)
Red flour beetle	*Tribolium castaneum* (Herbst)
Confused flour beetle	*Tribolium confusum* (Jacquelin du Val)
Saw-toothed grain beetle	*Oryzaephilus surinamensis* (Linnaeus)
Merchant grain beetle	*Oryzaephilus mercator* (Fauvel)
Hairy spider beetle	*Ptinus villiger* (Reitter)
Meal moth	*Pyralis farinalis* (Linnaeus)
Grain mite	*Acarus siro* Linnaeus
Long-haired mite	*Glycyphagus destructor* (Schrank)

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